



DRAINAGE DESIGN MANAGEMENT SYSTEM FOR WINDOWS VERSION 5.3.0

TUTORIAL # 2 DEVELOPING A NEW HEC-1 MODEL USING GIS SHAPEFILES



KVL Consultants, Inc.

DEVELOPING A NEW HEC-1 MODEL USING GIS SHAPEFILES

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1.0 ESTABLISH A NEW PROJECT AND SET DEFAULTS

Select *File* → *New Project*. Fill in the fields using the data shown in the screen capture below. Each project must have a unique Reference (without spaces), a formal Title, a project Location and an Agency name (this can be your firm's name if a consultant). Then select the appropriate Model (*HEC1* or *Rational*, but select HEC1 for this example), *Soils*, *Land Use* and *Roads Agency* and *Rainfall Method*. Finally select the appropriate HEC-1 parameters: *Unit Hydrograph*, *Loss Method*, *Storms*, *Duration*, *Tab Interval*, *No of Ordinates* and default *Output*. Also add any appropriate comments.

Select Project

List

Project Reference

Project ID: 00112 Reference: KVLEXAMPLE2

Title: Example 2 using Shape files and NOAA 14

Location: Maricopa County

Agency: KVL Consultants, Inc.

☐ River Mechanics Only ☐ Custom Storm Event

☐ Imported Hec-1 File

Project Defaults

Model: HEC1

Soils: FCDMC

Land Use: FCDMC

Rainfall: NOAA14

Roads: MCDOT

Return Periods to Model

1. 2 2. 5 3. 10 4. 25 5. 50 6. 100

This project is the tutorial example for establishing sub basin, land use and soils data from ESRI Shape files and also using the new NOAA 14 Rainfall.

HEC-1 Defaults

Unit Hydrograph: Clark

Loss Method: Green-Ampt

Storms: Single

Duration: 24 Hour

Tab Interval (NMIN): 3

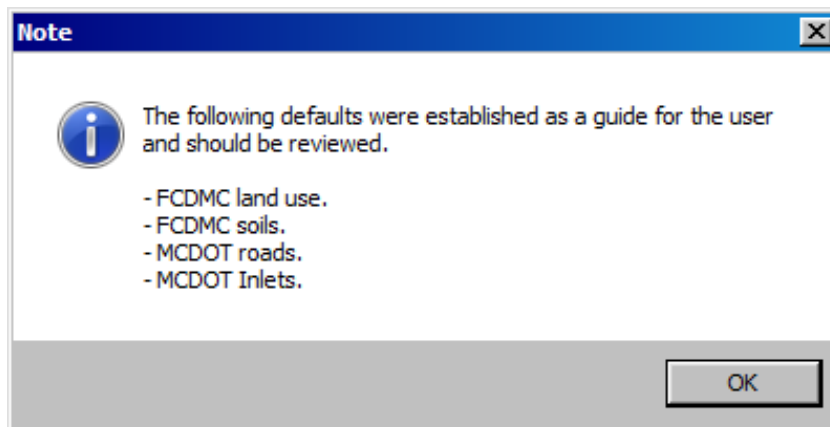
No. Ordinates (NQ): 2000

Output (IO): 5

Modification Date: 01/01/2011

Info Print... Delete Add OK

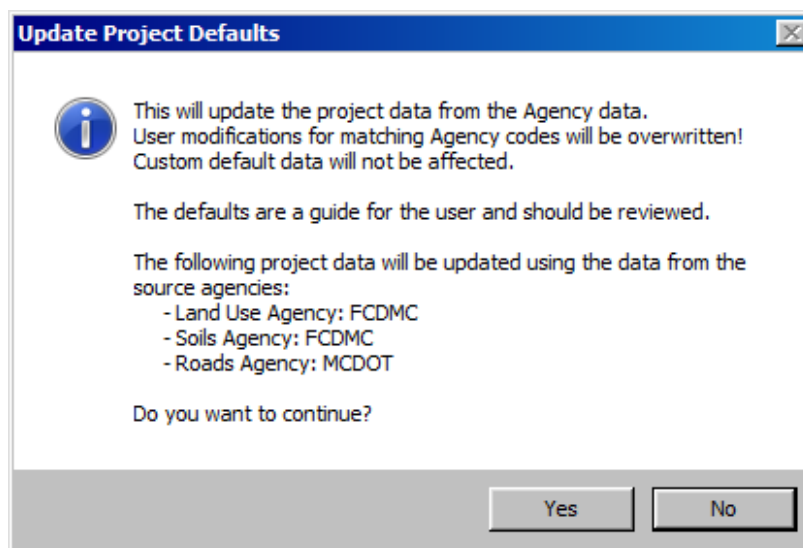
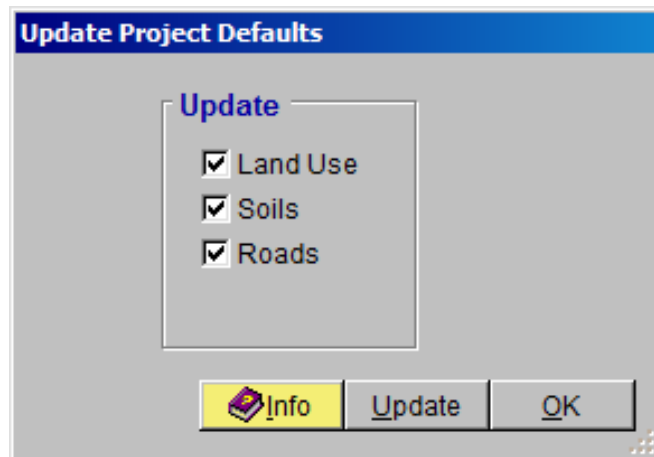
After entering the data, press 'Save'. Then, press 'OK.' to exit the Select Project form.



Then click 'OK' to accept the land use, soils, roads, and Inlets defaults.

2.0 UPDATE PROJECT DEFAULTS

Select *File* → *Update Project Defaults*. Check all the boxes and then press 'Update'.

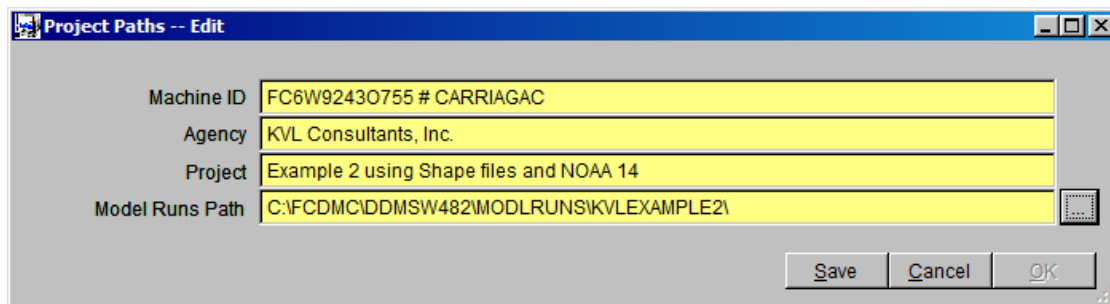


Click 'Yes' to continue. If the users have already made a lot of changes in either Land Use or Soils or both, and they want to preserve these changes, DO NOT click 'Yes'. That will overwrite all the changes already made.

3.0 SETTING THE MODEL RUNS PATH

When running models, the input and result files have similar file names for each project. Therefore to prevent one project overwriting the results of another project, it is necessary to establish a unique directory for each project's model runs.

Go to *File* → *Project Paths* to establish the model runs path. Press the ellipse button ('...') to the right of the '*Model Runs Path*' field and navigate to an appropriate directory. Identify and select this folder as the model runs path or press the '*Make New Folder*' button if the desired folder does not exist. Press '*OK*' after identifying and selecting the model runs path location. Press '*OK*' to close the Project Paths form. Note that the file path defined in the '*Model Runs Path*' in the following figure is not necessarily the same as the Model Runs Path for all users. The path depends on the location of the program installed.



Machine ID	FC6W92430755 # CARRIAGAC
Agency	KVL Consultants, Inc.
Project	Example 2 using Shape files and NOAA 14
Model Runs Path	C:\FCDMC\DDMSW482\MODLRUNS\KVL\EXAMPLE2\

Save Cancel OK

4.0 ESTABLISH MAJOR BASIN ID'S

Select *Hydrology* → *Major Basins* to access the *Major Basins* data. The software automatically establishes at least one *Major Basin* (01) when creating a new project. Since we will only have one major basin in this project, no modification on the form is needed at this time. After the sub basins are established, the user needs to return here to update *Major Basin* 01. Click on the '*OK*' button to close the form.

The screenshot shows the 'Major Basins' application window with the 'Details' tab selected. The 'Major Basin' section contains the following fields:

- Major Basin ID: 01
- Description: Major Basin 01
- Area (sq mi): 0.3510
- Rain ID: DEFAULT

The 'Modeling Options' section includes:

- Model This Major Basin: ☒ (with a 'Custom' link)
- Storms: Single
- Duration: 24 Hour
- Tab Interval: 3
- No. Ordinates: 2000
- Output: 5

The 'Reduction Factors' section features a table with 9 rows and 2 columns (Area and RF):

	Area	RF
1.	0.3510	0.9982
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		

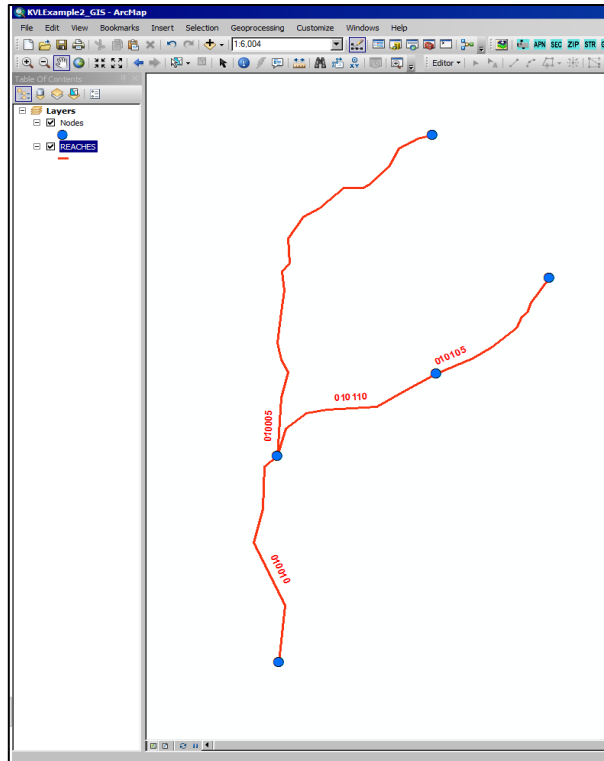
Below the table is a 'Custom' checkbox. The 'Return Period for Steps' section shows 'Step RP' as 100. At the bottom, there is a toolbar with buttons: Info, ReSort, Print..., Delete, Add, Update, and OK.

5.0 DIGITIZE THE DATASETS IN GIS

All GIS files must be in ESRI Shape file format.

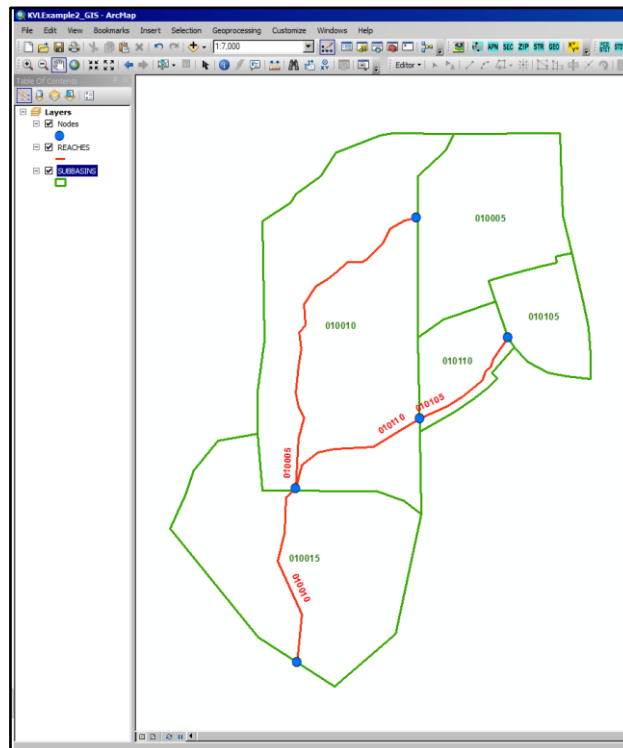
6.0 NODES AND ROUTING DATA

Digitize the Nodes and Routing data and provide Routing IDs for the routing reaches. The Nodes data shown are for cosmetic purposes only to show the location of the starting and ending points of routing reaches.



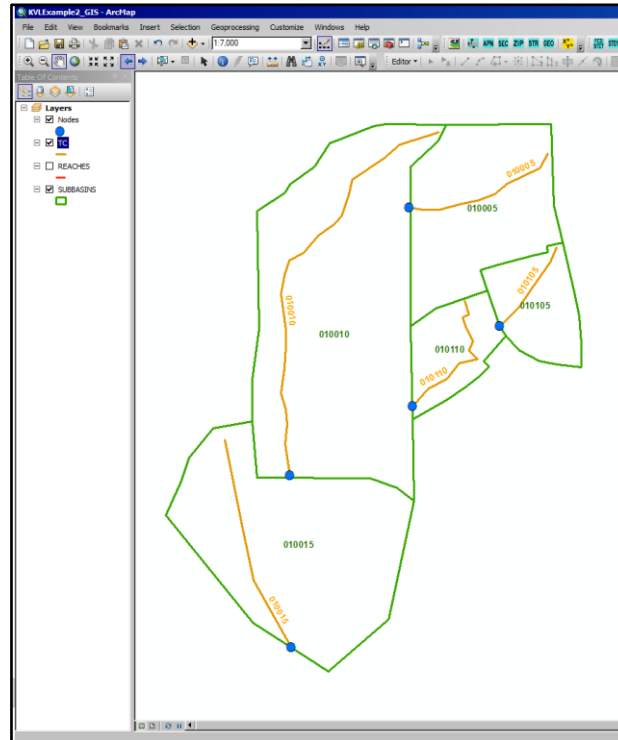
7.0 SUB BASINS

Digitize the Sub Basin areas and provide AREA IDs.



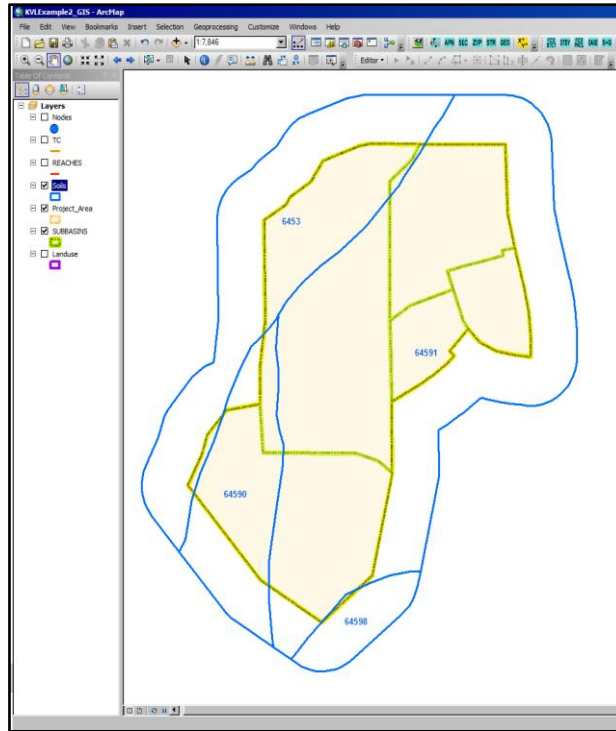
8.0 TIME OF CONCENTRATION, Tc

Digitize the Reach segments for the Sub basin areas from which the Time of Concentration information are derived. Enter the Upstream Ground Elevation (USGE) and Downstream Ground Elevation (DSGE) data.



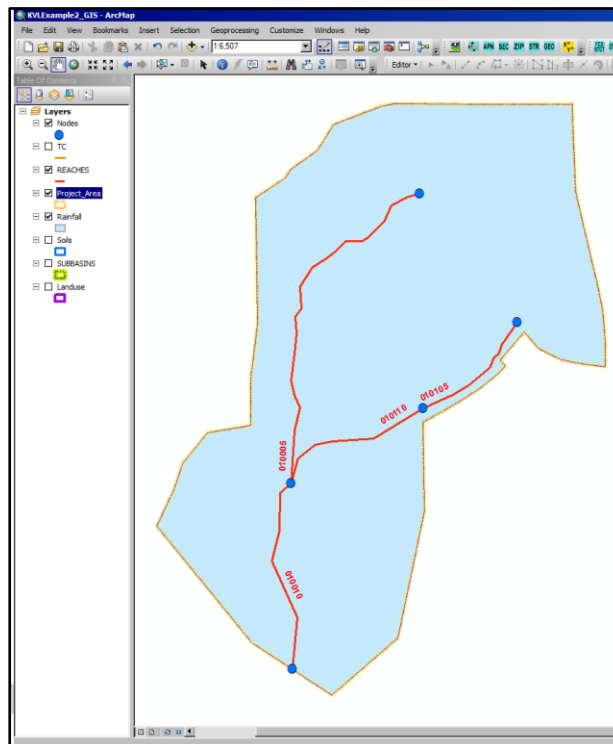
9.0 LAND USE

Obtain the Land Use Map, if it is available, or digitize the land use areas that should envelope the entire project area. Make sure that the Land Use codes used in the digitized land use maps are included in the Land Use Defaults defined in DDMSW.



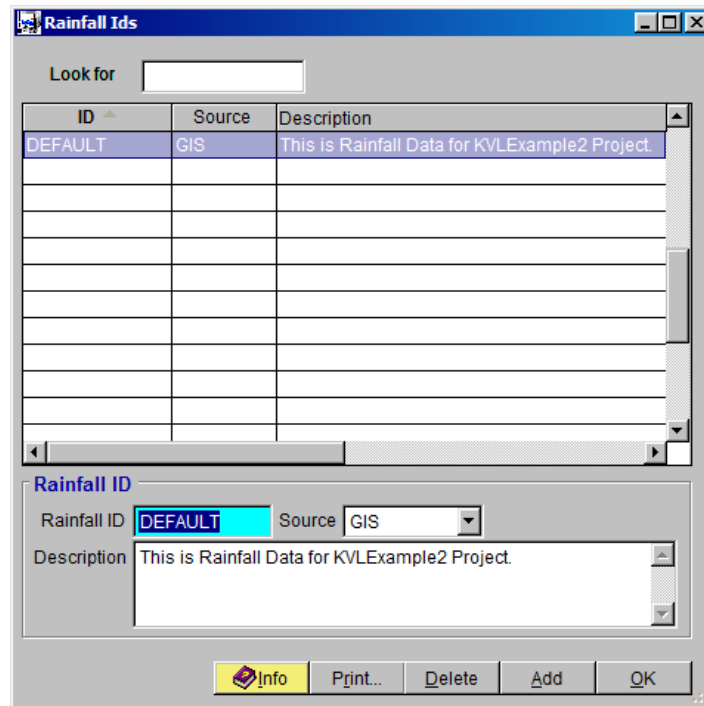
11.0 PROJECT AREA

Consolidate all the Sub Basin areas to define the extent of the Project Area. This consolidated polygon will be used to evaluate the Rainfall data for the project.



12.0 ESTABLISH RAINFALL DATA FOR PROJECT

Select *Hydrology* → *Rainfall Ids* and on the *Rainfall Ids* form to select *GIS* from the drop down menu. Type “*DEFAULT*” on the Rainfall ID textbox and add a text description on the Comment Box (Optional). Click the “Save” button to save the entered data and click “OK” to close the “Rainfall Ids” form.



The screenshot shows the 'Rainfall Ids' window. At the top is a 'Look for' search box. Below it is a table with three columns: 'ID', 'Source', and 'Description'. The first row is highlighted and contains 'DEFAULT', 'GIS', and 'This is Rainfall Data for KVLEExample2 Project.'. Below the table is a section titled 'Rainfall ID' with a 'Rainfall ID' text box containing 'DEFAULT', a 'Source' dropdown menu set to 'GIS', and a 'Description' text box containing 'This is Rainfall Data for KVLEExample2 Project.'. At the bottom are buttons for 'Info', 'Print...', 'Delete', 'Add', and 'OK'.

ID	Source	Description
DEFAULT	GIS	This is Rainfall Data for KVLEExample2 Project.

Rainfall ID

Rainfall ID: Source:

Description:

Select *Hydrology* → *Rainfall* and on the NOAA14 Rainfall form, locate and select the Rainfall map (Rainfall.shp) using the button on the right side of the Rainfall Map textbox. Click “Save” to save data and click *Update* to populate the Average Rainfall Data table for the six (6) Return Intervals (2 yr, 5-yr, 10-yr, 25-yr, 50 yr, and 10 yr) and 10 time durations (5 Min, 10 Min, 15 Min, 30 Min, 1 Hour, 2 Hour, 3 Hour, 6 Hour, 12 Hour, and 24 Hour). Note that the file path name defined in the ‘*Rainfall Map*’ as shown in the following figure might not be necessarily the same as the file path for individual modelers or users. The file path depends on the location of the shape files.

NOAA 14 Rainfall ID: DEFAULT

Rainfall Map

C:\FCDM\CDDMSW482\MAPS\KVLEXAMPLE2\RAINFALL.SHP

Required Map Fields

Average Rainfall Data for ID: DEFAULT

	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
5 Min	0.266	0.358	0.429	0.524	0.595	0.669
10 Min	0.404	0.545	0.653	0.796	0.906	1.018
15 Min	0.501	0.676	0.810	0.987	1.123	1.262
30 Min	0.675	0.911	1.090	1.330	1.513	1.700
1 Hour	0.835	1.127	1.349	1.646	1.872	2.104
2 Hour	0.968	1.286	1.530	1.862	2.110	2.368
3 Hour	1.048	1.369	1.623	1.977	2.258	2.549
6 Hour	1.241	1.581	1.854	2.224	2.512	2.812
12 Hour	1.420	1.792	2.084	2.478	2.781	3.094
24 Hour	1.689	2.187	2.585	3.141	3.582	4.044

Log Info Print... Update Rainfall ID OK

13.0 REVIEW SOIL DEFAULTS

Select *Hydrology* → *Soil Defaults* to view or to modify the Agency Soil Defaults or to add 'Custom' data. For this example custom values are not required. Click on the 'OK' button to close the form.

Soil Defaults

List Details

Look for Custom

Soil ID	Book	Map Unit	XKSAT	Rock Pct	Description
6451	645	1	0.410	0.00	Antho sandy loams
6452	645	2	0.410	0.00	Antho gravelly sandy loams
6453	645	3	0.580	0.00	Antho-Carrizo-Maripo complex
6454	645	4	0.580	0.00	Antho-Carrizo-Maripo complex, low precipitation
6455	645	5	0.430	0.00	Anthony sandy loam
6456	645	6	0.620	0.00	Anthony-Arizo complex
6457	645	7	0.620	0.00	Anthony-Arizo complex, low precipitation
6458	645	8	0.960	0.00	Arizo cobbly sandy loam
6459	645	9	0.270	0.00	Beeline-Cipriano complex, 3 to 45 percent slopes
6531	653	1	0.000	0.00	Agualt and Ripley soils
6532	653	2	0.000	0.00	Agualt and Ripley soils, saline-sodic
6533	653	3	0.660	0.00	Ajo-Gunsight-Pompeii complex, 3 to 25 percent slopes
6534	653	4	0.000	0.00	Akela-Rock outcrop complex, 15 to 65 percent slopes
6535	653	5	0.820	0.00	Carrizo-Dateland complex, 0 to 3 percent slopes
6536	653	6	1.200	0.00	Carrizo-Momoli complex, 0 to 3 percent slopes

Info Copy Print... Delete Add OK

14.0 REVIEW LAND USE DEFAULTS

Select *Hydrology* → *Land Use Defaults* to view or to modify Agency land use defaults or to add 'Custom' data. For this example custom values are not required. Click on the 'OK' button to close the form.

Sort	Code	Group	IA	Rtmp	Cover	Dtheta	Kb	Description
10	110	Residential	0.30	5	30.0	NORMAL	MIN	Rural Residential (<= 1/5 du pe
20	120	Residential	0.30	5	30.0	NORMAL	MIN	Estate Residential (1/5 du per s
30	130	Residential	0.30	15	50.0	NORMAL	MIN	Large Lot Residential - Single F
40	140	Residential	0.25	30	50.0	NORMAL	MIN	Medium Lot Residential - Single
50	150	Residential	0.25	30	50.0	NORMAL	MIN	Small Lot Residential - Single F
60	160	Residential	0.25	40	50.0	NORMAL	MIN	Very Small Lot Residential - Sin
70	170	Residential	0.25	45	50.0	NORMAL	MIN	Medium Density Residential - M
80	180	Residential	0.25	45	50.0	NORMAL	MIN	High Density Residential - Multi
90	190	Residential	0.25	45	50.0	NORMAL	MIN	Very High Density Residential -
100	200	Commercial	0.10	80	60.0	NORMAL	MIN	General Commercial (Commer
110	210	Commercial	0.10	80	65.0	NORMAL	MIN	Specialty Commercial (<=50,00
120	220	Commercial	0.10	80	65.0	NORMAL	MIN	Neighborhood Commercial (50
130	230	Commercial	0.10	80	75.0	NORMAL	MIN	Community Commercial (100,0
140	240	Commercial	0.10	80	65.0	NORMAL	MIN	Regional Commercial (500,000
150	250	Commercial	0.10	80	70.0	NORMAL	MIN	Super-Regional Commercial (>
160	300	Industrial	0.15	55	60.0	NORMAL	MIN	General Industrial (Industrial wt

15.0 UPDATE HYDROLOGY DATA

Select *Maps* → *Update Hydrology* to access the "Update Hydrology from GIS" form. Check the *Land Use*, *Soils* and *Tc* check boxes to be able to access the individual Name and Path of Maps for individual datasets that are used for updating the hydrology of the project. Locate the *Sub Basin*, *Land Use*, *Soils* and *Tc* shape files by clicking the locator button on the right side of each data text box. Once, all the Name and Path of Maps of datasets are defined, click on the '*Update*' button to establish the land use, soils, and sub basin data as well as to update the hydrologic model parameters. Note that the file path names defined in the '*Sub Basins*', '*Land Use*', '*Soils*', and '*Tc*' fields as shown in the following figure might not be necessarily the same as those file path names from individual modelers and users. The file paths depend on the location of the shape files.

Update hydrology from GIS - MB: 01

Name and Path of Maps for Hydrology

Sub Basins: C:\FCDMC\DDMSW482\Maps\KVLEXAMPLE2\SUBBASINS.shp

Land Use: C:\FCDMC\DDMSW482\Maps\KVLEXAMPLE2\LANDUSE.shp

Soils: C:\FCDMC\DDMSW482\Maps\KVLEXAMPLE2\SOILS.shp

Tc: C:\FCDMC\DDMSW482\Maps\KVLEXAMPLE2\TC.shp

Update Options

☒ Sub Basin

☒ Land Use

☒ Soils

☒ Tc

Major Basin

Major Basin: 01

Sub Basins Default

Time-Area: Urban

Map File Key Field Name

Land Use Code: LUCODE

Buttons: Info, Check Log, Update, OK

16.0 ESTABLISH ROUTING DATA

Select *Hydrology* → *HEC-1* → *Routing* to access the Routing data. Click on 'Add' to add the first record. Enter the data as shown for Route ID 010005.

HEC-1 Routing Data - MB: 01

Look for: []

ID	Type
010005	Kinematic Wave
010010	Kinematic Wave
010105	Kinematic Wave
010110	Kinematic Wave

Route

Major Basin ID: 01

Route ID: 010005

Type: KINEMATIC WAVE

☐ Channel Loss

Kinematic Wave

Shape: NATURAL

Length (ft): 2500.0

Slope (ft/ft): 0.0200

Man'g N: 0.035

Width (ft): 150.00

Side Slope (h/v): 1.00

Buttons: Info, Copy, Print..., Delete, Add, MB, OK

For this example, we will just make 3 copies (by clicking the Copy button) of this first record and change the Route ID to 010010, 010105, and 010110 each time.

17.0 ESTABLISH THE HEC-1 MODEL NETWORK

Select *Hydrology* → *HEC-1* → *Network* to access the “HEC-1 Model Network” form.

Sort	ID	Type	Retrieve ID	Combine	Area
10	010005	Basin			
20	010005	Route			
30	010105	Basin			
40	010105	Route			
50	010110	Basin			
60	010110	Combine		2	
70	010110	Route			
80	010010	Basin			
90	010010	Combine		3	
100	010010	Route			
110	010015	Basin			
120	010015	Combine		2	

Look for ☐ Exclude

Model Network

MB: 01
Sort: 10
Type: Basin
ID: 010005
KO Output: 0 ☐ Tape 21

Basin	Divert	ID
Combining	Retrieve	*
Route	Storage	KM Comment
Hydrograph	Special Code	

Info ReSort Copy Print... Delete Add MB Create Draft OK

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010005” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the first record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010005” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the second record.

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010105” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the third record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010105” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the fourth record.

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010110” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the fifth record.

Click “Add” and select “Combine” on the “Select Type” form. Click “OK” to close the “Select Type” form. On the ID textbox, enter “010110”. On the Combine textbox, enter 2, which requesting the program to combine two hydrographs. Click “Save” to save the sixth record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010110” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the seventh record.

Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010010” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the 8th record.

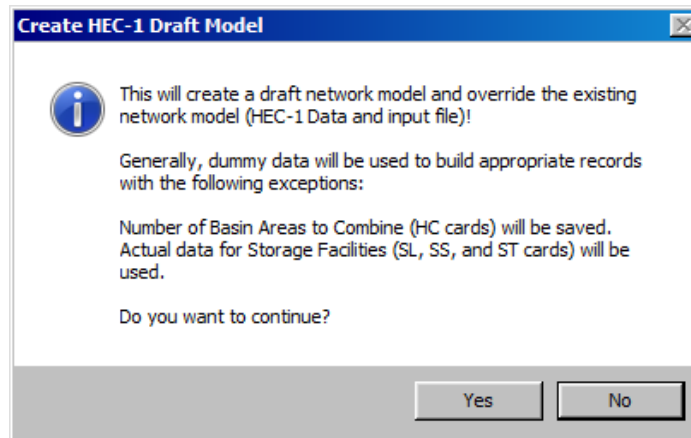
Click “Add” and select “Combine” on the “Select Type” form. Click “OK” to close the “Select Type” form. On the ID textbox, enter “010010”. On the Combine textbox, enter 3, which is requesting the program to combine three hydrographs. Click “Save” to save the 9th record.

Click “Add” and select “Route” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010010” as the Route ID. Click “OK” to close the “Select ID” form. Click “Save” to save the 10th record.

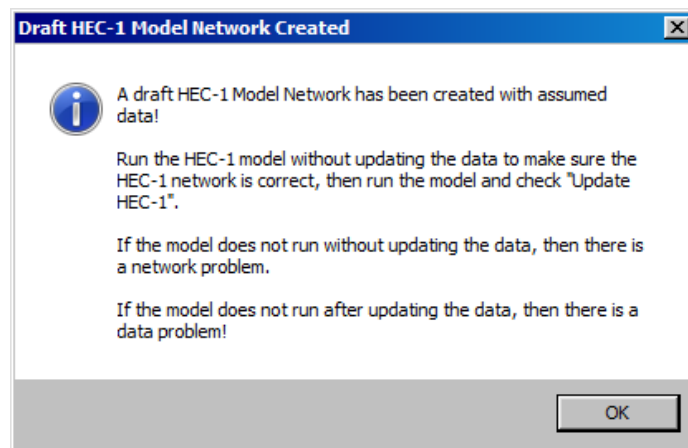
Click “Add” and select “Basin” on the “Select Type” form. Click “OK” to close the “Select Type” form. Click the Selector button on the right side of the ID textbox, and then select “010015” as the Subbasin ID. Click “OK” to close the “Select ID” form. Click “Save” to save the 8th record.

Click “Add” and select “Combine” on the “Select Type” form. Click “OK” to close the “Select Type” form. On the ID textbox, enter “010015”. On the Combine textbox, enter 2, which is requesting the program to combine two (2) hydrographs. Click “Save” to save the 11th record.

After all data has been entered click the ‘*Create Draft*’ button.



On the “Create HEC-1 Draft Model” form, click Yes for the program to create a HEC-1 Draft Model of the project. Click OK, to close the “Draft HEC-1 Model Network Created” form.



After exiting from the previous form, the program shows automatically the Draft “HEC-1 Model” file. Close the Text Editor after viewing file. Click “OK” to close the “HEC-1 Model Network” form.

```

Programmer's File Editor - [C:\FCDMC\DDMSW482\MODLRUNS\KVLXAMPLE2\01.Dat]
File Edit Options Template Execute Macro Window Help

ID KUL Consultants, Inc.
ID KULEXAMPLE2 - Example 2 using Shape files and NOAA 14
ID 100 Year
ID 24 Hour Storm
ID Unit Hydrograph: Clark
ID Storm: Single
ID 12/18/2014
*DIAGRAM
IT 3 0 2000
IO 5
IN 15
*
*
KK010005 BASIN
BA 1.0
PB 4.0
PC 0.000 0.002 0.005 0.008 0.011 0.014 0.017 0.020 0.023 0.026
PC 0.029 0.032 0.035 0.038 0.041 0.044 0.048 0.052 0.056 0.060
PC 0.064 0.068 0.072 0.076 0.080 0.085 0.090 0.095 0.100 0.105
PC 0.110 0.115 0.120 0.126 0.133 0.140 0.147 0.155 0.163 0.172
PC 0.181 0.191 0.203 0.218 0.236 0.257 0.283 0.387 0.663 0.707
PC 0.735 0.758 0.776 0.791 0.804 0.815 0.825 0.834 0.842 0.849
PC 0.856 0.863 0.869 0.875 0.881 0.887 0.893 0.898 0.903 0.908
PC 0.913 0.918 0.922 0.926 0.930 0.934 0.938 0.942 0.946 0.950
PC 0.953 0.956 0.959 0.962 0.965 0.968 0.971 0.974 0.977 0.980
PC 0.983 0.986 0.989 0.992 0.995 0.998 1.000
LG 0.15 0.25 4.50 0.50 50
UC 1.0 1.0
UA 0 5 16 30 65 77 84 90 94 97
UA 100
*
KK010005 ROUTE
RK 1000 0.005 0.025 TRAP 100 8
*
KK010105 BASIN
BA 1.0
LG 0.15 0.25 4.50 0.50 50
UC 1.0 1.0
UA 0 5 16 30 65 77 84 90 94 97
UA 100
*
KK010105 ROUTE
RK 1000 0.005 0.025 TRAP 100 8
*
KK010110 BASIN
BA 1.0
LG 0.15 0.25 4.50 0.50 50
UC 1.0 1.0
UA 0 5 16 30 65 77 84 90 94 97
UA 100
*
KK010110 COMBINE
HC 2
*
KK010110 ROUTE
RK 1000 0.005 0.025 TRAP 100 8
*
KK010010 BASIN

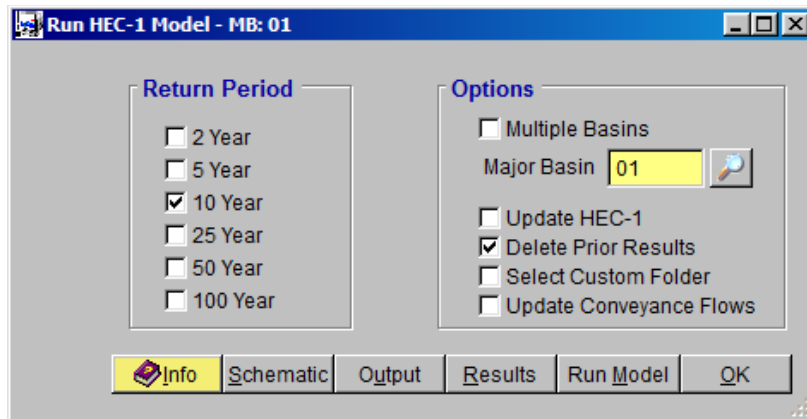
```

Ln 1 Col 1 81 WR Rec Off No Wrap DOS INS NUM

18.0 RUN THE DRAFT HEC-1 MODEL

Select *Hydrology* ➔ *HEC-1* ➔ *Model* to access the HEC-1 model.

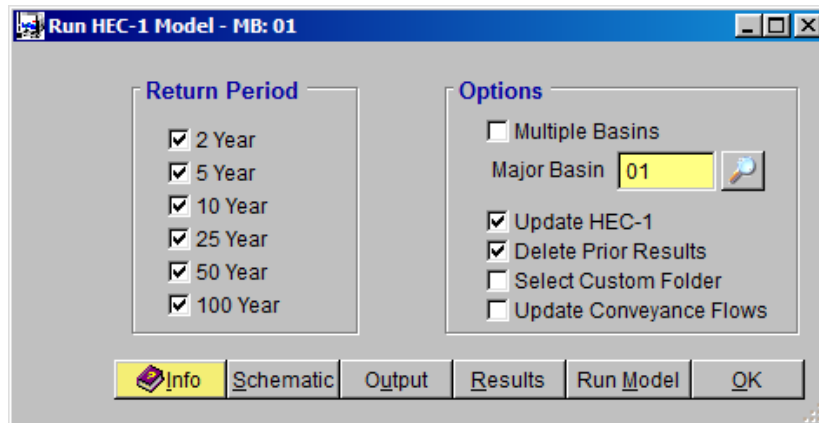
Check the '10 Year' Return Period and the 'Delete Prior Results' option. Uncheck all other return periods and options. Click 'Save' to save the entered preferences.



Click 'Run Model' to run the Draft HEC-1 Model. If the model runs without issues, it means that the HEC-1 Model Network that was built for the project is fine.

19.0 RUN THE FINAL HEC-1 MODEL

To run the model for all the return periods, click all the textboxes for the six return periods, and then check the "Update HEC-1" and "Delete Prior Results" options. Click "Save" to save the execution settings and run the model by clicking the "Run Model" button.



If the model runs correctly, it means the HEC-1 network and data are fine. The results can be viewed by clicking 'Results'. A full output file can be viewed with the 'Output' button, selecting the specific output file to view and pressing 'OK'. The 100-Year Schematic can be viewed by pressing the 'Schematic' button. Press 'OK' to close the

20.0 VIEW FLOW SUMMARY

HEC-1 Flow Summary - FLOWS - MB: 01


Look for:


ID	Sort	Type	Area	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	
010005	10	Hydrograph	0.0600	35	47	62	86	107	129	
010005	20	Routed	0.0600	34	45	62	86	102	126	
010105	30	Hydrograph	0.0200	7	10	16	26	33	42	
010105	40	Routed	0.0200	7	9	15	25	32	39	
010110	50	Hydrograph	0.0200	7	10	14	21	27	34	
010110	60	Combined	0.0500	10	13	22	36	47	60	
010110	70	Routed	0.0500	9	13	22	35	44	58	
010010	80	Hydrograph	0.1400	34	52	79	118	151	187	
010010	90	Combined	0.2500	68	99	142	212	265	326	
010010	100	Routed	0.2500	67	97	139	208	259	325	
010015	110	Hydrograph	0.1000	54	80	108	148	178	209	
010015	120	Combined	0.3500	85	127	181	272	350	431	


Info Export Storage Detail Print... View MB OK

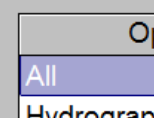
Model View

View Option

View 

Option 

 Info



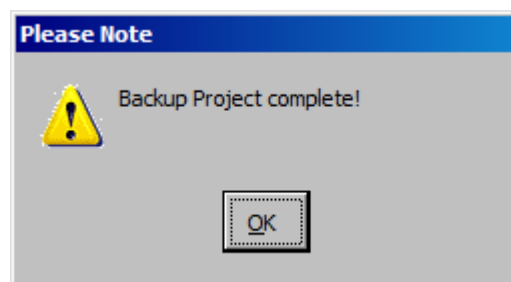
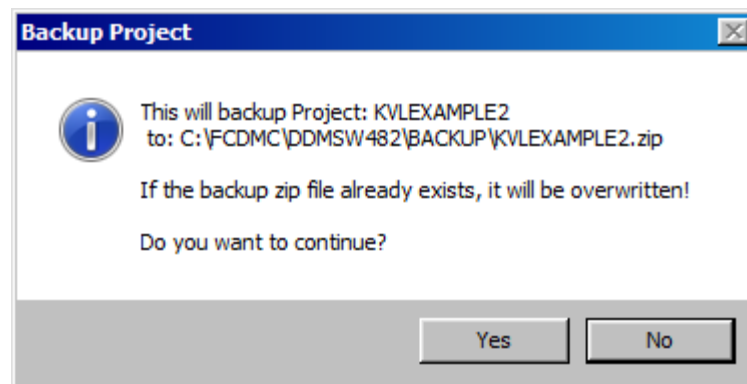
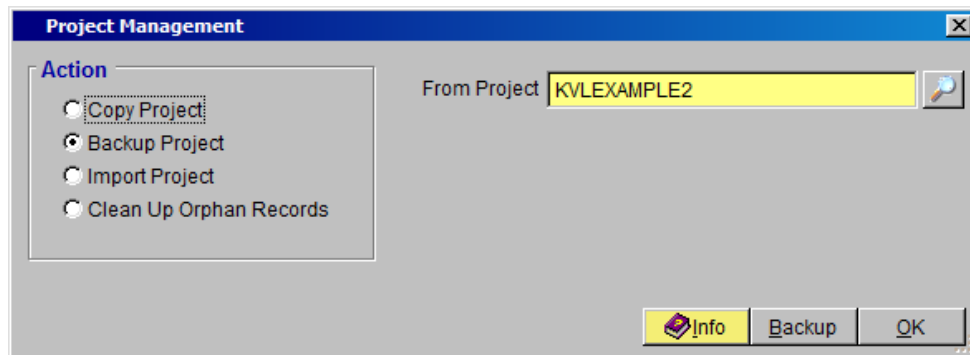
Select Option

Option
All
Hydrograph
Routed
Combined
Storage

OK Cancel

21.0 BACKUP PROJECT

Select *File* → *Project Management* to access the Project Management form. Select '*Backup Project*' as the *Action* and *KVLEXAMPLE2* as the project (use the adjacent button to select). Click the '*Backup*' button to create a backup copy of the project. Select the directory where the backup file should go and finally click '*OK*' when a directory is chosen. Click "Yes" to confirm.



This ends this tutorial.